Energy Savings from Commissioning the New Sofitel Hotel in New York City

Michael C. English, PE, CCP, LEED, Senior Partner
Horizon Engineering Associates, LLP
New York, NY

Rising thirty stories above the heart of midtown Manhattan, the 300,000-square-foot Sofitel Hotel is comprised of 400 luxury units, eight conference rooms and a 2,500-square-foot ballroom. Horizon Engineering Associates, LLP was hired by Accor North America to serve as the luxury hotel's Commissioning Authority.

The commissioning of Sofitel's mechanical, electrical, plumbing and fire protection systems was so successful that 99% of the hotel's guest rooms were available upon opening for business, and Horizon identified more than $200,000 in annual cost savings related to energy and maintenance deficiencies. Most importantly, our client's return on investment was just under two years to recoup the cost of commissioning the facility. Commissioning has ensured the energy-efficiency, reliability and durability of Sofitel's building systems for years to come.

INTRODUCTION

Horizon Engineering Associates, LLP served as Commissioning Authority for the Sofitel Hotel under contract to Accor North America, owner of the facility. The commissioning scope of work included all mechanical, electrical, plumbing and fire protection systems.

THE BUILDING

Located at 45 West 44th Street in Manhattan, the Sofitel Hotel is comprised of a 30-story central tower flanked on two sides by a pair of 20-story wings. The building was designed by Brennan Beer Gorman Architects and built by Component Assembly Systems, Inc., and mechanical engineering was performed by Cosentini Associates. The luxury hotel offers 400 guest rooms, eight conference rooms, a 2,500-square-foot ballroom and a variety of shops and restaurants. Construction of the tower began in 1997 and ended in 2000.

COMMISSIONING OBJECTIVES

Horizon's objective was to ensure that the commissioning process provided documented confirmation that building systems were installed and operated in accordance with the design intent. The aim of this process was to have the hotel fully operational on opening day with minimal service disruptions and guest complaints.

The commissioning of building systems by an independent expert was especially necessary to avoid conflicts of interest that typically arise when the system design firm or contractor is left to certify that its own equipment meets the operational and functional needs of the building owner.

As an independent consultant working on behalf of Accor North America, Horizon helped to bridge the gap between design, construction and occupancy by ensuring that the building was constructed, operated and maintained in accordance with the integrity and intent of the design. It was this commitment to design intent that served as a common bond between Accor North America, Horizon and the design and construction team.

COMMISSIONING PHILOSOPHY

Horizon performed all commissioning functions from the perspective of the owner, taking advantage of the operational background shared by the firm's principal commissioning agents. Because Horizon commissioned the facility as if the firm was going to operate it for the next twenty years, the quality of the project was reflected by improved energy efficiency, sufficient access to equipment, better operational characteristics and effective training of personnel.

COMMISSIONING SCOPE OF SERVICES

Horizon performed commissioning services for all mechanical, electrical, plumbing and fire protection systems during the design, construction and turnover phases.

Design Phase

During the Design Phase, Horizon performed a design review of all the mechanical plans and specifications developed by the design professional. This review concentrated on operational aspects of the design to ensure that the equipment would operate in accordance with each of the manufacturers' guidelines, service capabilities and operation of a fully functioning system. This review also verified that the design intent was met by the design documents.

Horizon reviewed the Basis of Design and Design Intent Document to ensure that these guidelines would be adhered to in the commissioning process, and will assist the owner in developing and applying a long-term vision for building functionality. During this phase Horizon also developed the Commissioning Plan, including the development of the pre-functional and functional checklists. The plan also included a timeline, coordinated with the construction team, detailing when and how specific tests would occur.

Construction Phase

During the Construction Phase, Horizon developed the commissioning specification and observed the installation of equipment according to project documents. The firm began coordination of equipment start-up and testing, and scheduled manufacturer representatives for review and start-up. Horizon documented the construction process, began operations training and documentation and witnessed necessary hydrostatic tests, duct leakage tests or any and all other testing as required in specification.

In particular, Horizon reviewed the shop drawings and submittals from an operational standpoint to develop the most feasible way to install equipment for both performance and serviceability, and reviewed and commented on RFIs when applicable. Horizon was present to evaluate the installation process, including an inspection of installed equipment to ensure that it was installed according to manufacturer standards, design documents and the local code having jurisdiction over the project.

As part of a Systems Performance Assessment the firm performed the following acceptance procedures: verification; functional performance testing; and testing, adjusting and balancing. Any deficiencies noted during this phase were documented. Horizon worked with the contractor to determine the specific parties to oversee and witness testing, conduct testing and supply testing equipment. Inspection visits were conducted and reports were generated in accordance with the commissioning plan.

Verification comprised a full range of checks and tests to determine that all components, equipment, systems and interfaces operated in accordance with contract documents. This included all operating modes, interlocks, control responses and all specified responses to abnormal or emergency conditions. All verification procedures were directed and witnessed by Horizon and all results certified. Any operating deficiencies were documented and corrected by the responsible party concurrently and re-tested until accepted.

Functional Performance Testing progressed from tests of individual components of the central equipment to tests of the systems that contain those pieces of equipment. Horizon ensured that the correct procedure was implemented and all systems functioned properly. Horizon also performed a field verification of the final testing, adjusting and balancing report for all trades and directly witnessed and certified the results. A sample of the report was selected for verification, and the testing, adjusting and balancing contractors were notified of the final verification.

Horizon documented all deficiencies identified in the mechanical systems during the verification process and reported them to the construction team. Horizon and the responsible contractors scheduled re-testing of these items. Horizon also managed and administered any and all deficiencies for the duration of the project. An onsite deficiency log was present at all times, and Horizon reported the deficiencies in document format during commissioning meetings with the trades.

Turnover Phase

The operations training program coordinated by Horizon furnished a thorough understanding of all equipment, components and overall systems. Horizon oversaw the training program, including scheduling attendance by all manufacturer representatives, to ensure that the program afforded attendees the proper training in and knowledge of system descriptions, capabilities and limitations; system operational procedures for all modes of operation; acceptable tolerances for system adjustments; procedures for dealing with abnormal conditions and emergency situations; and use of operating and maintenance manuals. Horizon also ensured that equipment tagging was complete as applicable and performed correctly, including pipe labeling, valve schedules and as-built drawings.

Horizon was also in responsible charge of making sure that O&M manuals were submitted as per the specifications and included all manufacturer literature pertaining to the project. The O&M manuals included instructions for installation, maintenance, replacement and start-up; special maintenance requirements and sources for parts and equipment; on-hand parts list and recommended spares; a list of special tools that would be required; performance data; and warranty information.

Post Occupancy Phase

Horizon managed the warranty period as required within the specifications. The firm documented any warranty issues as they arose and recommended action plans to resolve the situation. Horizon also furnished a final commissioning report detailing the project process. This report included an evaluation of the operating condition of the facility; deficiencies identified and corrective measures applied; uncorrected deficiencies that were accepted by the owner; functional tests and procedures; reports documenting all field commissioning activities; and a schedule of deferred testing.

DEFICIENCY IDENTIFICATION/RESOLUTION

Horizon addressed and resolved several dozen deficiencies to ensure the energy-efficient and cost effective operation of building systems. The following is just a representative sample.

Mechanical and Electrical Systems

Horizon discovered missing access doors on the ductwork for fire dampers and volume dampers, required for building personnel to service and maintain this equipment. Also, the firm identified Building Automation Computer deficiencies such as economizer functions and freeze stat operation. When outside air conditions permit, the building automation system utilizes an economizer program to use outside air to maintain temperature and humidity, but due to a programming error, when outside conditions were below freezing, the air handling unit would trip on freeze stat protection because a minimum temperature in the mixing box was not maintained. Horizon was able to resolve this issue due to commissioning.

The firm identified clogged coils in the guest room fan coil units. After recording discharge temperatures during a functional inspection, the inspector noted minimal temperature changes from the cooling to heating mode. Upon further investigation, the contractor had used too much solder while welding the pipe connections. Horizon ensured the appropriate mitigation of this deficiency as well.

During the pre-functional inspection of fan coil units in guest rooms, issues such as unconnected drains or actuators not installed were found by Horizon. These items if not repaired, would have caused inadequate temperature conditions in the guest rooms and stained ceilings.

The smoke purge system was another area in which Horizon identified deficiencies. The smoke purge system consists of smoke purge fans and fire smoke dampers, and is used by the Fire Department to evacuate the building of smoke. However, the design intent was unclear to the installer and as a result, the system was installed incorrectly. During Horizon's system functional test, system deficiencies were identified and as a result a redesign was issued.

In another instance, the lightning protection design was to install grounding rounds through the underling building foundation, but the electrical contractor failed to install the grounding rods in fear of penetrating the underground water table. Because failure to install lightning protection will result in increase insurance premiums and potential personnel injury, the system was ultimately installed.

Also, during the emergency generator test, inadequate emergency lighting for the guest room corridors was identified, and a redesign issued.

Fire Alarm and Plumbing Systems

Horizon also identified deficiencies in the fire alarm and plumbing systems, including manual pull stations and speaker strobes not functioning correctly with the fire detection system, and inadequate water pressure, leaking faucets, clogged toilets and unconnected drains found in the plumbing system. Also, the engineer designed the B1 domestic hot water system with a heat trace system, as opposed to a re-circulation line, but the plumbing contractor failed to install the heat trace wiring. As a result, the guest would use excess water waiting for the temperature to rise. These systems were fixed prior to the hotel opening for business.

Additionally, the sewage ejector pump is required to collect and pump sewage from the basement and sub basement level. During a pre-functional inspection, Horizon noted that the pump did not have sufficient head to pump the sewage up to the street level. The pump manufacturer installed a new impeller so the system would operate properly.

Other deficiencies throughout the building included leaking ductwork in the fourth-floor mechanical engineering room; un-calibrated sensors on air handling units; closed, missing and unwired fire dampers causing airflow restrictions and inadequate fire protection; unbalanced air and water systems; and unlabeled electrical panels, to name a few.

OPERATIONAL BENEFITS

The commissioning process was so successful that **99% of the hotel's guest rooms were available** upon opening for business. Horizon ensured that the staff training was properly facilitated and executed,

Table A: Deficiency Identification & Cost Savings			
Item	***Deficiency***	***Instances Repeated***	***Estimated Cost Savings***
1	Air duct not insulated	12	$9,500.00
2	FCU condensate line pitched incorrectly	12	$13,500.00
3	Main drain back pitched	38	$34,400.00
4	Intake air filters dirty	283	$24,055.00
5	Piping lines run across intake to fan coil restricting flow	94	$23,750.00
6	Holes in duct must be sealed	12	$7,350.00
7	Diffuser missing	5	$3,250.00
8	Supply diffuser offset with duct	10	$6,100.00
9	Drain line elbow missing insulation	13	$4,900.00
10	Actuator not connected to valve	14	$12,700.00

and the firm inspected equipment for optimum performance and accessibility. This now allows equipment to be operated more efficiently and at a lower cost, and grants operations staff improved access to equipment, saving time and money on long-term maintenance costs.

By having a Commissioning Authority on this project, Accor Hotels was able to reduce the amount of operating staff on site prior to opening day. Once this day approached, the operations group was fully staffed and in dire need of operations training.

Horizon ensured that the training was properly facilitated and executed. Our Commissioning Agents assisted in the manufacturer training and provided hands on experience allowing the operating personnel to thoroughly understand the facility. With this expert training, the hotel operations staff was capable of identifying problems early. This allowed the operations staff to repair potential problems early and not to impede with the operation of the hotel.

With Horizon inspecting equipment for optimum performance and accessibility, it allowed equipment to operate at a lower cost. It also allowed the operations staff the luxury of performing maintenance on equipment with the proper accessibility.

FINANCIAL BENEFITS

Horizon helped Accor North America realize **more than $200,000 in annual cost savings** related to the identification and resolution of nearly 50 deficiencies, many of them repeated a dozen times each.

These savings included approximately $71,000 per year related to the resolution of piping layout deficiencies; $24,000 per year related to the resolution of dirty intake air filters, a deficiency repeated over 280 times; and $10,000 per year associated with an air duct found to be lacking insulation. *Table A* and *Table B* provide representative samples of deficiencies and their respective cost and energy savings.

Most importantly, it will take the owner just under two years to recoup the cost of commissioning the facility.

AWARDS

Sofitel Hotel received the 2000 Emporis Best New Skyscraper Award for design and functionality.

Table B: Energy & Cost Savings			
Item	***Deficiency***	***Estimated Energy Savings***	***Estimated Cost Savings***
1	Faulty AHU-2 air temperature sensor	37,756 kwh	$6,041.00
2	AHU-5 delivering too much air	4,573 kwh	$732.00
3	Faulty AHU-14 air temperature sensor	22,331 kwh	$8,754.00
5	Chilled water pump VFDs not programmed to maintain design flow rate	29,176 kwh	$4,668.00
6	10 fan coil units with clogged cooling and/or heating coils	2,838 kwh	$454.00
7	Chilled water valve remains open on 7 fan coil units	15,149 kwh	$5,594.00
8	All fan coil units have dirty filters	163,199 kwh	$26,112.00
9	Six AHUs trip due to faulty freeze stat program	41,246 kwh	$39,294.00
10	Heating valve stays open on 14 fan coil units	35,348 kwh	$20,621.00
11	Piping restricting air intake on numerous fan coil units	8,692 kwh	$1,391.00
12	Unit heater heating valve does not close	153 kwh	$2,459.00